ANALYSIS OF NUTRITION OF RACEHORSES (CATEGORY OF TWO-YEAR OLD HORSES) IN THE REPUTABLE RACING STABLE

S. Froňková, B. Hučko, A. Kodeš, Z. Mudřík

Czech University of Agriculture, Faculty of Agrobiology, Food and Natural Resources, Department of Microbiology, Nutrition and Dietetics, Prague, Czech Republic

The study was aimed at nutrition of racehorses of the category two-year old horses in an ordinary racing stable where experienced trainers are working. The authors wanted to demonstrate actually applied feed rations as followed from the results and comparison of actual nutrient supply and energy with equine actual requirement and not only to study the conditions in nutrition of these horses as well as to find the ways how to optimise and create prerequisites for reaching their maximal performance. It can be concluded from the results obtained that racehorse trainers have been still maintaining a tendency to feed all horses in the stable by identical feed rations without respecting their individual requirements. The feeds used are not of corresponding quality as it should be in loaded horses. This documented the comparison of results the real requirement of energy with real consumption of energy. The average requirement of energy (PE) by horses in the rest time were 67.99 MJ SE_k and the real consumption of energy were (SPE) were 83.14 MJ SE_k. The different is very conclusive. The PE by horses in the preparatory period (middle load) were 81.31 MJ SE_k and SPE were 94.47 MJ SE_k. Different is very conclusive. By horses in the maximal performance (high load) the different were opposite. PE 103.47 MJ SE_k and SPE only 96.25 MJ SE_k This fact is very important for effectiveness of horses and for their health.

racehorse; requirement of nutrients and energy; feeds applied

INTRODUCTION

Despite of other species of the livestock, the problem of equine nutrition and feeding is more complex, performance of horses cannot be assessed objectively.

The nutrition and feeding have a dominant effect on the total health of horses, their condition, growth, development as well as reproduction, and the effect on profitability cannot be forgotten. The general practice in training centres is to study the horses and their feeding based on the trainer's experience, respecting performance, live weight, condition, health, etc. Horses have very intensive and specific conversion of energy. The full utilisation of this biological efficiency capacity prerequisites a perfect cover of their requirement for nutrition and energy.

Above all, the capacity of their respiratory and cardiovascular system, red corpuscles counts and purposefulness of their muscular and skeletal system give the performance of racehorses. The function of training is to keep or increase the performance of different organs and the feeding is its basic prerequisite.

When evaluating the energy requirement for horses in congruency with the transition to international system of units SI, feed units (e.g. oat and starch unit) in the Czech Republic are replaced by energy unit, such as SE – digestible energy, ME – metabolizable energy and NE – net energy. The unit used in the Czech Republic is SE_k – digestible energy for horses [MJ] (Zeman, Tomanová, 1995).

The energy requirement in an adult horse is higher than in other livestock. It is evidently caused by the fact that a horse requirements more energy for spontaneous activity than other species of livestock. The equation for estimation of energy requirement recommended (NRC, 1978) did not correspond (Potter, 1987) to the differences in requirements among different horse breeds (it was overestimated for ponies, on the contrary, underestimated for thoroughbred horses). Therefore Pagan and Hintz (1986) designed a new equation that better expresses sustainable requirement of digestible energy for horses. The definition of the requirement of digestible energy for horses (SE_k) is based on it, given in MJ, as it was published in recommendation issued by the Commission for Nutrition and Feeding of Livestock at the Czechoslovak Academy of Sciences (Zeman, Tomanová, 1995):

$$ZPE\ (SE_k \text{ in MJ/day}) = 0.649\ MJ\ .\ H^{0.75}$$

Meyer and Coenen (2003) confirmed this. Under the normal weather conditions, they recommend a daily consumption of 0.6 MJ (0.55–0.63) of digestible energy per kg of live weight$^{0.75}$ for sustenance of the horse. It is approximately 64 MJ of digestible energy for a horse weighing 500 kg.

The work exerted only by the locomotion itself cannot be calculated by the general formula work = weight of animal x length of the track, because an actual amount of energy supplied depends on the type and velocity of the locomotion, terrain and substrate of the track, weather conditions, training of the horse and not at least, the weight and artfulness of the rider.

In racehorses the energy requirement is rising with increasing velocity of the locomotion respecting the length of gallop by parabolic dependence and at the highest velocity, it reaches short-term extreme values. Meyer

and Coenen (2003) reported that this uneven growth during locomotion of higher velocity is caused by significant vertical shift of the whole body (during gallop), higher losses of friction of hooves on the ground, and among other things, also by transition to anaerobic way of obtaining of energy.

Maximal short-term exercises are required from racehorses. Standardisation of energy requirement in these horses is done on the basis of conversion of work into thermal energy. Working horse needs not only energy for work but also sustainable requirement, which includes also greater requirement of normal locomotion of the body.

The difference in the requirement of energy between the working and not working horse ranges about 25% (Zeman et al., 1997) under practical conditions. The horse cannot do the work with the same intensity during the whole day. Maynard and Loosley (1960) found the efficiency of energy conversion falls on average up to 12% with increasing rate of work.

The estimate of the content of digestible energy in feed is done from digestible nutrients using multiple regression equation.

The equation after Zeman and Tomanová (1995) is recommended for practical use:

$$SE_k\ (MJ) = 11.10 + 0.0038 \times NL + 0.0184 \times fibre - 0.0002 \times fibre^2$$

The aim of our work was, compare of energy requirement of two year horses per time of rest, per middle load and high load in the race horses stable Velká Chuchle. In the ground of results we give the proposal for the next time.

MATERIAL AND METHODS

The experimental studies were carried out with racehorses of the English thoroughbred (A1/1) in racing stables of the Agricultural Apprentice School in Prague-Velká Chuchle with the trainers Ing. Marcela Sýkorová, Miroslav Šusta, Theodor Pechát who are also employed as shop foremen at this school which is attended by the pupils in the branch Jockey and tenders of racehorses.

These investigations were carried out for five years, in the years 1998 to 2002. Three four-week investigations (training mesocycles) were performed each year (training macrocycle), i.e. in the preparatory, racing and transitional period, were done with 15 horses. The age category of horses is two years.

The horses were stabled in the racecourse in Velká Chuchle in the stables owned by the company TMM, s.r.o. (limited-liability company) individually in the boxes of an area 4 x 4 metres equipped by automated feed pump, on the litter with straw or sawdust.

The horses were fed three times a day individually by their age, training period and service load. The basic feed ration was composed of hay, oats and carrot in the winter period. In the preparatory period and during the racing season they are fed 2–3 times a week by mash, other days they are given warm bran. Energy granules are added individually to the feed before the race to the given horse according to the possibilities (manufactured by the company Biofaktory, s.r.o., Praha – Nutri Horse energet.

After finishing of the race season the ration of the concentrated feedstuff is continuously falling and the hay rate is increasing up to 10–12 kg, in the preparatory period bulk feeds are gradually added individually, respecting the growing load of different horses and in the racing season the amount of fed oats reaches the highest values, the amount of fed hay is much falling.

Analysis of the condition and feeding of racehorses in the racing stable of the Agricultural Apprentice School Velká Chuchle in different periods was concentrated on:

- monitoring of the quality and quantity of feed rations particularly in view of energy value
- evaluation and estimation of the reasons of the differences found in comparison of actual requirements with claimed needs.

Analyses of the feeds were done in the laboratory of the Department of Microbiology, Nutrition and Dietetics of the Czech University of Agriculture Prague based on the methodologies used in feeding laboratories according to the recommendations of the Central Institute for Supervising and Testing in Agriculture.

Live weight of horses was studied always at the beginning and at the end of the experimental period. Weight was calculated using a formula from the circumference of the chest and length of the body from shoulder joint to pin bone as recommended by Frape (1998).

Energy of work – calculations were determined by live weight of a horse, weight of rider, type of work and lasting of work.

The differences were evaluated in the content of energy in feed ration regarding calculated requirements by working load of horses in different periods of the year. The data were statistically established using statistical methods in the program Excel:

- Student *t*-classification to find dependencies of evaluated selections (two-selection *t*-test with unevenness of dispersions)
- correlation coefficient to find dependencies
- linear regression analysis to settle linear dependencies.

RESULTS AND DISCUSSION

Investigations and experiments, when we studied load of different horses during different periods of the year and their individually changing level of feed ration, led us to an opinion that unnecessary overfeeding of horses, and on the contrary, in the periods of maximal utilisation their feed ration under the level of calculated requirements and it is not able to provide the required intake of energy. The results obtained showed the primary role in

the feeding of racehorses is played by fulfilment of the demands for energy that are much different from above all by working load. The demand for crude protein in extreme performances is not much different from sustainable requirements. Nehring (1952), Zeman et al. (1997) and Dušek et al. (1999) also confirmed this. Hanák (1998) remarked to this that excess of proteins in feed can disorder metabolism and to decrease the performance of the studied horse. Meyer et al. (1991) reported that to sustain the horses need approximately 5 g of crude digestible protein per 1 MJ of digestible energy. The ratio up to 10 : 1 is tolerated. It means that the requirement of proteins for horses weighing 500 kg does not reach more than 1000 g. Whereas NRC (1989) recommends for horses of this weight with intensive load 1312 g. This study was aimed mainly at studying of the level of nutrition in view of energy.

Racehorse was bred to give performances in the rate on shorter distances, and therefore it cannot be calculated that the horse will give a performance in gallop or extreme load for longer period of time. The reached times in horse racing are ranging between 1 minute (racing of around 1000 m distance) to above 2 minutes (racing around 2000 m distance).

In the resting time when a horse works in trot or walk (this period serves for relaxation and rest after racing season), its requirement is 80 MJ of SE (digestible energy). In the preparatory period when the horse works in gallop, its energy requirement is rising, i.e. by 15 MJ to 95 MJ (about18%), and in racing time when a horse participates in racing, i.e. under extreme load, its energy requirement is higher by 42 MJ (to the value 122 MJ), what is an increase by 53% of energy requirement compared with the rest and even by 77% above the level of sustainable requirement of energy.

Energy supply is the most frequent limiting factor of high performance of horses due to the daily sustainable energy requirement and energy requirement of sports horses for production of body heat and for their performance is relatively high. This can be seen in authors' data found and also Tlučhoř (1997) confirms this and reports the need of energy during intensive work that can rise even by 100% above the sustainable ration. Hanák (1983) indicate that during muscular work only 25–30% of energy is converted into locomotion energy, the rest falls to thermal energy that a body cannot utilise. Recommendation of the Commission for Nutrition of the Czech Academy of Agricultural Sciences (1995) gives the coefficient of utilisation of the digestible energy into muscular work about 26 to 30%.

Table 1 gives the values found during investigations in different horses. Data are arranged by age and weight of horses. Sustainable need of energy in MJ SE_k (ZPE) and minimal and maximal values of energy in MJ SE_k (PE) are calculated from these values at low, medium and high load. The last three columns give actually found consumption of energy in feed ration (MJ SE_k) that was administered to horses at rest (low load), preparatory period (medium load) and racing time (high load).

The values found are presented in well-arranged graphs (Fig. 1–3), individually for age category of two-year old horses, in different times of the year. Each graph gives for comparison also mean values of these needs (PE_R) except maximal and minimal limits of calculated need of energy (PE min and PE max). Actually

Table 1. Primary data

Name of the horse	Age	Year of study	Weight (kg)	Maintenance requirement of energy ZPE	Low load		Middle load		High load		Consumption (MJ) of energy per period of rest SPE	Consumption (MJ) of energy per preparatory period SPE	Consumption (MJ) of energy per racing period SPE
					Requirement of energy min (MJ) PE	Requirement of energy Max (MJ) PE	Requirement of energy min (MJ) PE	Requirement of energy Max (MJ) PE	Requirement of energy min (MJ) PE	Requirement of energy Max (MJ) PE			
Migas	2	2001	350	50.3	52.8	62.9	62.9	75.5	75.5	100.6	83.14	86.98	87.43
Mafira	2	2001	350	50.3	52.8	62.9	62.9	75.5	75.5	100.6	83.14	87.26	89.51
Tamaó	2	2001	375	53.4	56.1	66.8	66.8	80.1	80.1	106.8	88.23	89.91	93.42
Far Beck	2	2002	380	54.1	56.8	67.6	67.6	81.2	81.2	108.2	86.43	93.7	96.38
Langlade	2	2000	400	56.5	59.3	70.6	70.6	84.8	84.8	113	88.75	97.13	95.27
Nagan	2	2002	400	56.5	59.3	70.6	70.6	84.8	84.8	113	87.17	89.45	90.5
Somebody	2	2001	425	59.6	62.6	74.5	74.5	89.4	89.4	119.2	89.62	91.48	93.25
Long Time	2	2001	425	59.6	62.6	74.5	74.5	89.4	89.4	119.2	89.73	93.51	96.48
Silver Stone	2	2000	430	60.2	63.2	75.3	75.3	90.3	90.3	120.4	92.15	94.6	95.8
Tajuta	2	1998	440	61.5	64.6	76.9	76.9	92.3	92.3	123	90.12	91.36	89.69
Dytana	2	1998	450	62.7	65.8	78.4	78.4	94.1	94.1	125.4	94.48	93.28	94.18
Fergas	2	1998	450	62.7	65.8	78.4	78.4	94.1	94.1	125.4	96.33	102.57	112.47
Marel	2	2002	460	64	67.2	80	80	96	96	128	95.82	96.42	95.77
Libverda	2	1998	470	65.2	68.5	81.5	81.5	97.8	97.8	130.4	96.33	102.57	104.36
IGihara	2	1998	510	70.2	73.7	87.8	87.8	105.3	105.3	140.4	98.58	106.82	109.21

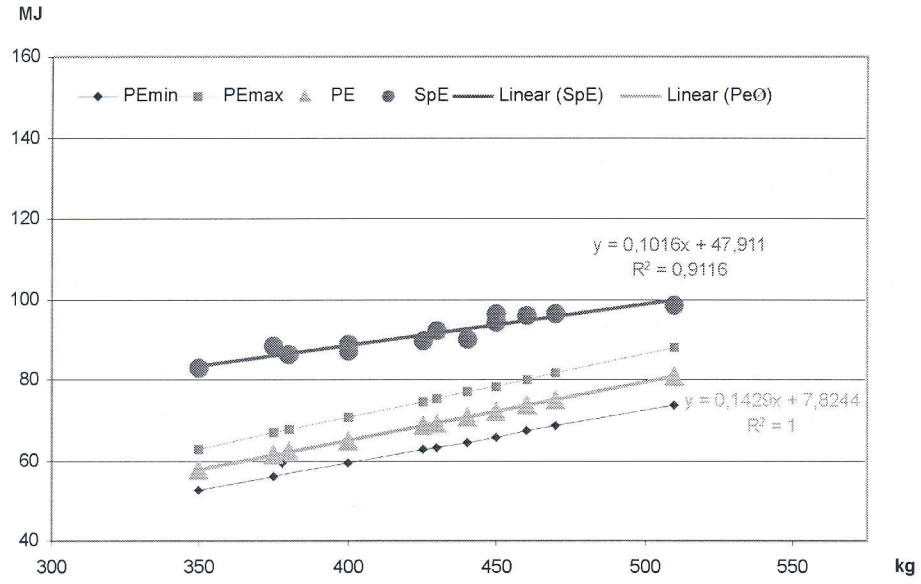

Fig. 1. Comparison of PE and SpE – two-year old horses – time of rest

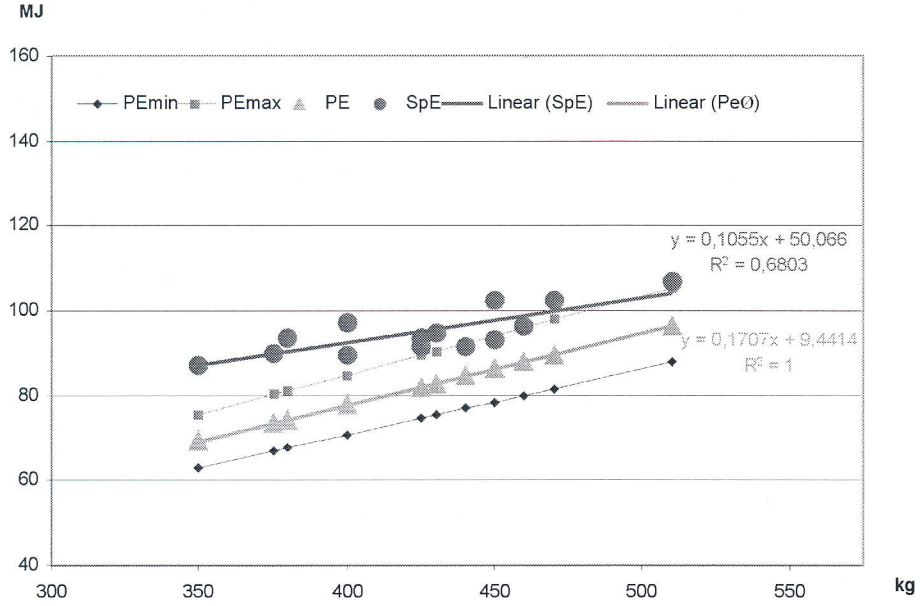

Fig. 2. Comparison of PE and SpE – two-year old horses – preparatory period

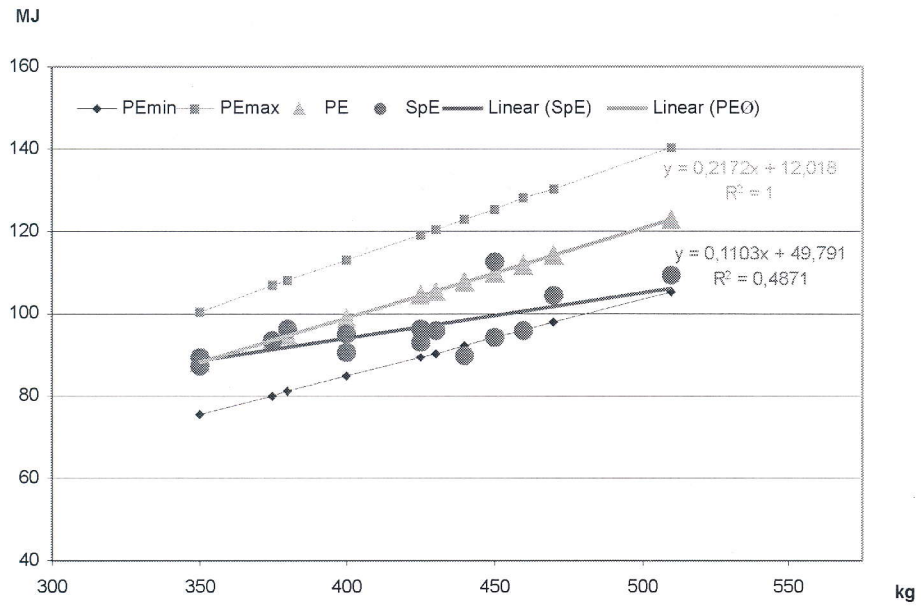

Fig. 3. Comparison of PE and SpE – two-year old horses – racing period

found energy consumption (SpE) are picked out by red. Regression lines are interposed by the values SpE and $PE_{\bar{R}}$. Their equations and correlation coefficients are given in each graph.

These graphs show that two-year old horses at rest and low load receive more energy (SpE) than are maximal calculated needs of energy under the given load (PE max). In the preparatory period actual energy consumption (SpE) are close to calculated maximal needs (PE max), i.e. mainly in higher weight categories. The horses of the weight 350–400 kg have a visible excess of accepted energy (SpE) above the value of maximal need (PE max). In the racing time SpE values are ranging within the values of calculated needs, but under the mean of these needs ($PE_{\varnothing}$), i.e. in higher weight categories. Actual intake of energy in the horse Tajuta is even 2.6 MJ SE_k lower than the maximal limit of calculated need (PE min). From design of the SpE values it is also apparent that the content of energy in feed ration at rest (work of horses is similar) in different horses considering their weight is not much different while in the racing time under individual training load this energy content in some horses is significantly differentiated. For example, SpE in the horse Fergas is higher by 2.7 MJ SE_k than the average value of energy need ($PE_{\varnothing}$) and even higher by 23 MJ SE_k than energy intake in Tajuta.

The values found were statistically assessed by two-selection *t*-test with unevenness of dispersion by different age categories (Table 2). The results showed statistically significant dependencies among the values of average needs of energy ($PE_{\varnothing}$) and the values of actual energy consumption (SpE) in all studied groups. It follows from the above data that the data found are suitable for making conclusions also on the level of significance 1.

CONCLUSION

It can be judged from the results that in all age categories of racehorses in certain period an excessive intake of energy appears and on the contrary, in the period of high working load it is a problem to give these horses such amount of energy that could cover calculated need. In winter when working load of racehorses is minimal, the excess of supplied energy is reaching up to 20 MJ SE_k, i.e. it exceeds a sustaining need of energy for studied horses even by 40%. In two-year old horses this excess of taken energy could be tolerated for the reason that these horses are finishing their growth and development, is not considered by the resources for calculation of energy requirements (recommendation of the Czech Academy of Agriculture). In other age categories it can be judged that these horses convalesce after finished racing season and take reserves for further racing period.

In the preparatory period in which horses gather muscularity for the coming season or they deposit slight reserves of fat, the values found indicate higher intake of energy than are calculated requirements, i.e. more in horses of lower weight categories, in horses above 500 kg these values almost replicate the upper limit of calculated values.

On the contrary, in the racing time when high or frequently extreme load of racehorses appear and load of different horses is more variable than in the previous periods, in some cases they do not cover taken amount of energy of calculated requirement, particularly in horses of the weight above 500 kg. It can be explained in several ways: administered feed does not contain a required amount of energy due to low quality. Some horses are more psychically labile in this period and can be fed worse and increased requirement of energy is apparently supplied from the reserves created in the period of rest and preparation for the racing period. The differences in weight of some horses at the beginning and end of the racing season indicate this. Certain differences in the values found in the consumption of energy among different horses can be explained by different temperament, eventually by health problems that the horse faced mainly in the racing period.

The above results show that racing trainers continue in trends to feed all horses in their stable uniformly without respecting their individual requirements, i.e. by their weight or working load. The feedstuffs administered are not always of the best quality, as it should be expected in horses loaded in this way. Therefore it should be recommended:

- to feed the racehorses several times a day to have a possibility to take a required amount of feed, i.e. in the racing season

Table 2. Two-selection *t*-test – two-year old horses

	Time of rest		Preparatory period		Racing period	
	PE ∅	SpE	PE ∅	SpE	PE ∅	SpE
Mean value	67.99	90.67	81.31	94.47	103.47	96.25
Dispersion	41.96	23.24	59.87	33.59	96.95	51.35
Observation	15	15	15	15	15	15
Hypothetical difference of mean value	0		0		0	
Difference	26		26		26	
t stat	–10.88		–5.27		2.3	
P (T <= t) (1)	1.79E–11		–8.2E–06		–0.0149	
t 0.5	1.71		1.71		1.71	
t1	2.12		2.12		2.12	
Correlation coefficient	0.955		0.825		0.698	

- to keep the requirement for the best quality of the feed, mainly of hay and oats
- to administer a part of oats in mashed form to increase digestibility
- to substitute a part of oats by other feeds with higher content of energy, e.g. maize or with energy supplementary mixtures in the racing period and in highly loaded horses
- certain amount of energy can be supplemented by adding of quality vegetable oil that will provide also intake of essential fatty acids.

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FROŇKOVÁ, S. – HUČKO, B. – KODEŠ, A. – MUDŘÍK, Z. (Česká zemědělská univerzita, Fakulta agrobiologie, potravinových a přírodních zdrojů, katedra mikrobiologie, výživy a dietetiky, Praha, Česká republika) :

Analýza výživy dostihových koní (kategorie dvouletí) v renomované dostihové stáji.

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V práci jsme se zaměřili na výživu dostihových koní kategorie dvouletých v průměrné dostihové stáji, kde působí zkušení trenéři. Byl srovnáván obsah živin a energie u skutečně použitých krmných dávek, skutečné dotace živin a energie s jejich skutečnou potřebou, vypočítanou podle doporučení komise výživy ČAZ. Chtěli jsme demonstrovat nejen stávající, obvyklý stav ve výživě dostihových koní, ale pokusit se najít cesty, jak stav ve výživě dostihových koní optimalizovat a vytvořit předpoklady pro dosahování jejich maximální výkonnosti. U dostihových trenérů přetrvávají tendence krmit všechny koně ve své stáji jednotně, bez zohlednění jejich individuálních požadavků. Dokazují to výsledky srovnání potřeby a skutečné spotřeby energie.

Průměrná potřeba energie (PE) u koní v pracovním klidu byla stanovena na 67,99 MJ SE_k a vypočtená skutečná spoptřeba energie (SPE) byla 83,14 MJ SE_k. Rozdíl je vysoce průkazný.

U koní v mírné zátěži byl také vysoce průkazný rozdíl – PE byla 81,31 MJ SE_K a SPE byla 94,47 MJ SE_k.

U koní v zátěži tomu bylo opačně – PE byla v tomto případě 103,47 MJ SE_k a vypočtená skutečná spotřeba SPE byla 96,25 MJ SE_k. Tento fakt je velmi důležitý pro výkonnost koní a jejich zdraví.

dostihový kůň; potřeba živin a energie; používaná krmiva

Contact Address:

Ing. Boris H u č k o , CSc., Česká zemědělská univerzita v Praze, Fakulta agrobiologie, potravinových a přírodních zdrojů, katedra mikrobiologie, výživy a dietetiky, Kamýcká 957, 165 21 Praha 6-Suchdol, Česká republika, tel.: +420 224 382 675, e-mail: hucko@af.czu.cz